Event anisotropy in momentum and coordinate space

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The event anisotropy in the azimuthal distribution of particles is often characterized by v_1, v_2 and called directed and elliptic flow respectively. This anisotropy, especially v_2, plays an important role in high energy nucleus-nucleus collisions and is expected to be even more important at RHIC energies[1]. At a given rapidity (y) and p_t interval the coefficients are determined by[2],

$$v_n = < \cos[n(\phi - \Psi_r)] >,$$

where Ψ_r denotes the reaction plane angle. Similarly this Fourier expansion can be done in coordinate space, where for a given rapidity and p_t interval the coefficients are determined by

$$r_n = < \cos[n(\mathrm{atan}(\frac{y}{x}) - \Psi_r)] >$$

and x, y are the coordinates at freeze-out.

Comparing the anisotropy parameters in momentum space (v_n) with the anisotropy parameters in coordinate space (r_n) as a function of p_t helps us to understand the space-time evolution of nucleus-nucleus collisions[3]. To predict this space-time evolution at RHIC, Au+Au collisions at $\sqrt{s} = 200$ AGeV have been studied using the RQMD v2.4 model.

Figs. 1a-d show the first harmonic both in momentum and coordinate space for nucleons and pions. At mid-rapidity note the similar shape of v_1 versus y and r_1 versus y for nucleons. Here both the slopes of v_1 versus y and r_1 versus y show a reversal of sign. This finds an explanation in a picture with strong (positive) space-momentum correlations, taking into account the correlation between nucleon stopping and the original position of the nucleons in the transverse

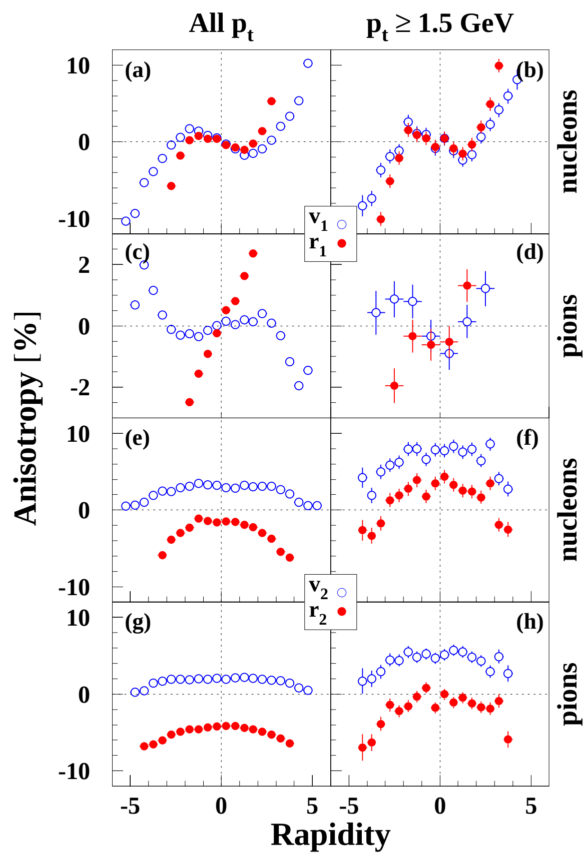

Figure 1: *Anisotropy parameters for nucleons and charged pions in RQMD, using an impact parameter range of 5 ≤ b ≤ 10 fm.*

plane. For pions, the rapidity dependence of v_1 is predominantly governed by rescattering on comoving nucleons. Figs. 1e-f show the second harmonic for nucleons and pions. For both nucleons and pions v_2 is positive and is larger for particles with $p_t \geq 1.5$ GeV. Particles acquire a large p_t when they are produced by a hard collision (which should not produce an event anisotropy) or when they have a large number of soft collisions (rescattering). The latter would explain the increase in v_2 and it explains why r_2 goes from negative for nucleons integrated over all p_t to positive for nucleons with large p_t.

Footnotes and References

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